Permanent Cathodic Protection Monitoring Systems for Offshore Pipelines

Ross Fielding
Deepwater EU Limited.
Elstead, UK.
Presentation Outline

• Limitations of existing methods
• Do we need “Close Interval Potential Survey” offshore?
• Improved in-line tools
• Subsea CP test stations
• Future surveillance options
Limitations of Existing Methods

- **Must have periodic pipeline contact to re-calibrate (every 5 -10 Kms max).**
- **Expensive**
  - Need ROV, RSV, GPS, Bathymetry, Pipe Track, CP Equip, People
- **Unreliable**
  - Many error sources
  - Hard to assure repeatability
- **Surveys that do not re-calibrate are meaningless**
Typical Survey Data
Typical Survey Data (3 Electrode Survey)

Less than 10 mV potential spread over 3 Kms.
This is typical of virtually all offshore pipelines.
2 data points over this section could have defined condition.
Do we need “Close Interval Potential” data on Offshore Pipelines?

• The answer is NO.
  – We could accurately define pipeline CP performance range with a data point every 5 -10 Kms. If that data point were totally repeatable.
  – Attenuation modeling could predict worst case between two points.

• In Fact
  – The contact readings on any “close Interval Potential Survey (CIPS)” are used to anchor the reported profile on all methods, the data between the contacts is somewhat superfluous.
Attenuation Calculation Output

![Graph showing CP Potential Attenuation over Distance Along Pipeline (Feet)](image)
Improved In-Line Tools

- The Baker PMG – CPCM (Cathodic Protection Current Mapping) Tool has been used on offshore retrofitted lines and clearly shows anode sled locations.

- This method of monitoring is un-ambiguous, the current flow can be calibrated to a current density, and a few external potential reference points to fully define CP system.

www.stoprust.com

© 2013 Deepwater Corrosion Services Inc.
RetroSled Being Installed
Typical CPCM Chart at RetroSled

Retrosled Anode Sled draining 0.82A from U/S and 0.23A from D/S
Total Amperage = 1.05A

Caliper Data

Current Flow
Why Are Spaced Test Points Acceptable?

• Onshore CP used Test Stations until problems were noted as follows:
  – IR Errors from mainly ICCP systems
  – Induced AC
  – Short range resistivity changes
  – Stray Current interference from other DC sources (DC Traction, other ICCP Systems etc)

• Because of these issues CIPS was introduced in the early 1980’s, and became SOP by early 90’s.
Why Spaced CP Test Stations Are Valid Offshore

- No IR Errors – virtually no ICCP on offshore lines
- No AC interference – no overhead power lines or ROW sharing
- No short-range resistivity changes
- No DC traction systems, or sources of stray current interference
- No problem sampling at 5-10 km intervals
Subsea CP Test Station Components

- **Permanent Reference Electrode**
  - Use dual electrode (Zn / Ag-AgCl) for calibration

- **Reference Ground Connection to Pipe**
  - Made with RetroClamp which also mounts the electrode

- **Voltage Display**
  - Reads the reference electrode potentials

- **Redundant Stab Plate**
  - Separate stab plate for back-up, particularly important on buried pipelines

www.stoprust.com
Reference Electrodes

- Several Manufacturers.
- Do they have In-Situ calibration or a Plan B

- Dual reference electrode
  - Zinc sw
  - Ag/AgCl sw

- 25 Year Life
- Provides pipe/seawater potential
- Shown direct welded to PLET Skid

www.stoprust.com
Grounding / Mounting Clamp

- Reference electrode attached to dual clamps prior to overboarding and installation
  - Cable is protected within a steel reinforced rubber hose
Readout – Voltage Display

- Light powered readout uses photo-voltaic converters
Readout – Voltage Display

- Buoyant spheres for pipeline monitoring.
Readout – Voltage Display
Back-Up Stab Plate

- Provides an insulated reference connection to pipeline for use with a tip contact CP Probe

© 2013 Deepwater Corrosion Services Inc.
Integrated Clamp System for Deep Water Flowline Mid-Point Monitoring

© 2013 Deepwater Corrosion Services Inc.
Integrated Clamp System for Deep Water Flowlines
AUV Surveys – The future
Summary

- Conventional ROV mounted inspection techniques are expensive will be out of the market in the near future.
- Permanently installed pipeline monitoring systems allow more rapid, reliable assessment of pipeline CP status at a fraction of the cost.
- As AUV’s (Autonomous Underwater Vehicles) take on the role of pipeline external inspection the visual indicators will evolve into the primary offshore CP monitoring tool.
- Many subsea pipelines are not “pigable” however, In-Line tools could carry much of the CP inspection burden on candidate pipelines.
- Acoustic Devices are being trialed, again limitations exist.
Presentation Finished

Thank You for Your Attention